Transition Of Optical Algorithms/Models To NAVOCEANO

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LONG-TERM GOALS

Work on this contract started on April 1, 1999. This is a long-term (potentially up to 5 years) effort to collect promising results from ONR's Environmental Optics Program and package them as products which can be used by the Fleet. An important part of the effort is to make sure that the potential products are correctly transitioned to NAVOCEANO. The PI is located at Stennis Space Center and can interact on a daily basis with personnel at NAVOCEANO to identify products needed by the Fleet. Collaboration with NRL-Stennis and NRL-DC will be needed for specific optical products and has been arranged.

OBJECTIVES

Anticipated optical products from this effort will revolve around the characterization of the optical environment in which the warfighter will find himself and the performance, in that environment, of optically-based assets to be available to him within the next 5 years. **Environmental characterization** can be accomplished with either historical databases, in-situ measurements, remote sensing or predictive modeling from hydrodynamical simulations. **Asset performance** includes modeling of diver visibility and soon to be available laser-based systems with optical inputs obtained from the environmental characterization methods mentioned above.

APPROACH

In order to transition any product into operational support at NAVOCEANO, it is necessary to interact with NAVOCEANO personnel on a daily basis. The PI's company, Planning Systems Incorporated, is presently renting a building on site at Stennis Space Center, MS, allowing for this critical interaction. Coordination with NAVOCEANO will be anchored around the following POCs: Kimberley Davis-Lunde, Ken Matulewski, Annetta Vitale. Bill McQueary, an initial POC, has accepted a Fleet Representative position and will no longer be able to support transitions to NAVOCEANO.

The PI will also work closely with on-site personnel at Commander, Naval Meteorology and Oceanography Command (CNMOC) to identify algorithms and models for transition and to identify the most effective NAVOCEANO support tool in which to integrate. A number of scientists, from PSI and the Navy, familiar with the accepted transition process used for ocean, atmospheric, and acoustic models through the Oceanographic and Atmospheric Master Library (OAML), or Administrative Model Oversight Panel (AMOP) processes. The experience of these individuals will be leveraged to assist the PI.

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In order to successfully transition Optics R&D results, it is first necessary to identify a need within the Navy that the transition will satisfy. The PI is serving as a liaison with ONR as well as with NAVOCEANO personnel to assure the clear understanding of the enhanced capabilities that an identified transition will provide.

Initially, each potential transition will be evaluated by the PI in association with the R&D developer to allow a full understanding of the Fleet application. Then, the PI will work closely with NAVOCEANO and CNMOC counterparts to identify potential integration pathways, weighing alternatives between pathways, and providing written recommendations concerning where within the NAVOCEANO daily operations the transition must be integrated.

As concerns **environmental characterization**, potential transitions will arise from research and work being performed on in-situ measurements, historical databases, remote sensing and predictive modeling. The PI will therefore interact with the following researchers:

In-situ measurements: Robert Maffione at HOBI Labs, Scott McLean at Satlantic, Scott Pegau atOregon State University, Alan Weidemann at NRL-Stennis.
Historical databases: Jeff Smart at Woods Hole Oceanographic Institution, Laurie Jugan at Planning Systems Incorporated, Kimberley Davis-Lunde at NAVOCEANO.
Remote sensing: Ken Carder at University of South Florida, Ron Holyer at University of Southern Mississippi, Curtiss Davis at NRL-DC, Bob Arnone[1] and Walter Smith at NRL-Stennis.
Predictive modeling: Paul Bissett at Florida Environmental Research Institute, John Walsh and Bob Weisberg at University of Florida, Scott Glenn at Rutgers University.

Coordination with NRL involves the following POCs: Bill Snyder and Curtiss Davis at NRL-DC for the NEMO satellite hyperspectral algorithms; Bob Arnone for the Automated Processing System (APS) at NRL-Stennis.

In regards to **asset performance prediction** in that environment, an important Fleet concern is the development of fast algorithms to predict diver visibility in various environmental conditions. At NAVOCEANO's request and with NRL funding, the PI has developed a fast interactive diver visibility algorithm which accurately models the Contrast Transmittance Theory (CTT). Because CTT does not include image blurring due to forward scattering, future improvements involving the Modulation Transfer Function (MTF) are needed for a more realistic algorithm to be transitioned to the Fleet.

Other optical assets include several laser-based systems which will be transitioned to the Fleet within the next 5 years. The Fleet will therefore need an operational product to decide which system to deploy under specific environmental conditions. The PI, through ONR funding, is presently developing the Generic Lidar Model to address NAVOCEANO's requested needs. The PI briefed NAVOCEANO's CO in April 1999 and was given a letter of recommendation for GLM by the Technical Director at NAVOCEANO, followed by a similar support letter from COMNAVMETOCCOM. Work with Professor G. Kattawar at Texas A&M is being planned for model validation with the help of Monte Carlo simulations.

WORK COMPLETED

As previously mentioned, work on this project started on April 1, 1999. Since then, preliminary algorithms have been obtained from Bill Snyder at NRL-DC concerning ATREM and Chlorophyll,

CDOM and Kd490. Work so far has been focused on researching the literature behind these algorithms. Coordination with NAVOCEANO personnel has been initiated and an office with a computer for the PI now exists within NAVOCEANO space.

NAVOCEANO is acquiring SeaWiFS imagery in areas of interest and Bob Arnone's APS has been installed at NAVOCEANO. SEADAS software has been downloaded from the SeaWiFS website. PSI personnel are preparing for the evaluation of the APS under separate contract with NAVOCEANO. Under this contract, support necessary to implement the system will be provided.

The PI attended the quarterly HyCODE meeting hosted by ONR and held at Stennis Space Center in August. He presented a brief on the Generic Lidar Model and reviewed other talks and technologies for potential transition. The PI also traveled to Denver for a technical presentation during SPIE's annual conference.

Work is also focussing on the transition of GLM to NAVOCEANO. A GUI has been designed to incorporate all the environmental algorithms: horizontally layered atmosphere and water column, sea surface and ocean bottom. Figure 1 below is a picture of a page in the GUI which assists the user in setting up the scene: system depth, target location and type, and ocean bottom depth and type. The diagram on the right interacts with the user as inputs are changed, thereby giving a visual illustration and confirmation of the user inputs. Although this figure only shows an underwater system, GLM is capable of handling airborne systems as shown in Figure 2 where a moored mine is seen at an altitude of 20 meters over the sea surface from a pulsed range-gated system. The two pictures to the left represent performance in clear water under a flat sea surface (top) and a sea surface ruffled by a wind blowing at a speed of 1 knot. The two pictures to the right represent the same system's performance in turbid waters. GLM presently simulates nighttime scenarios only.
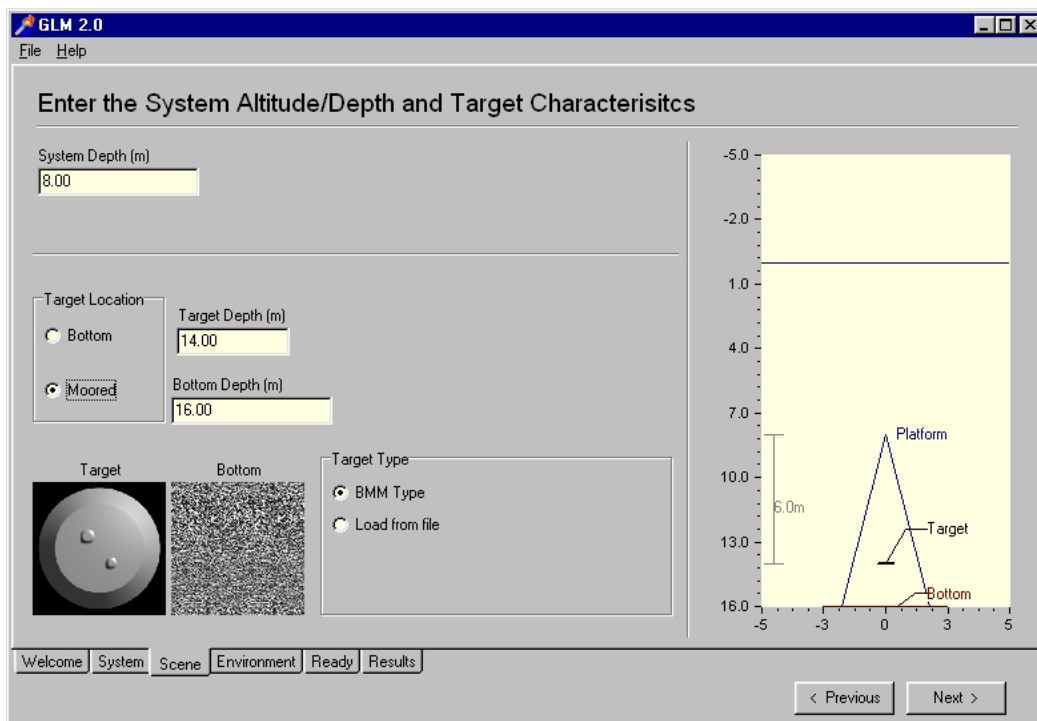
1. Scene page of the GLM GUI
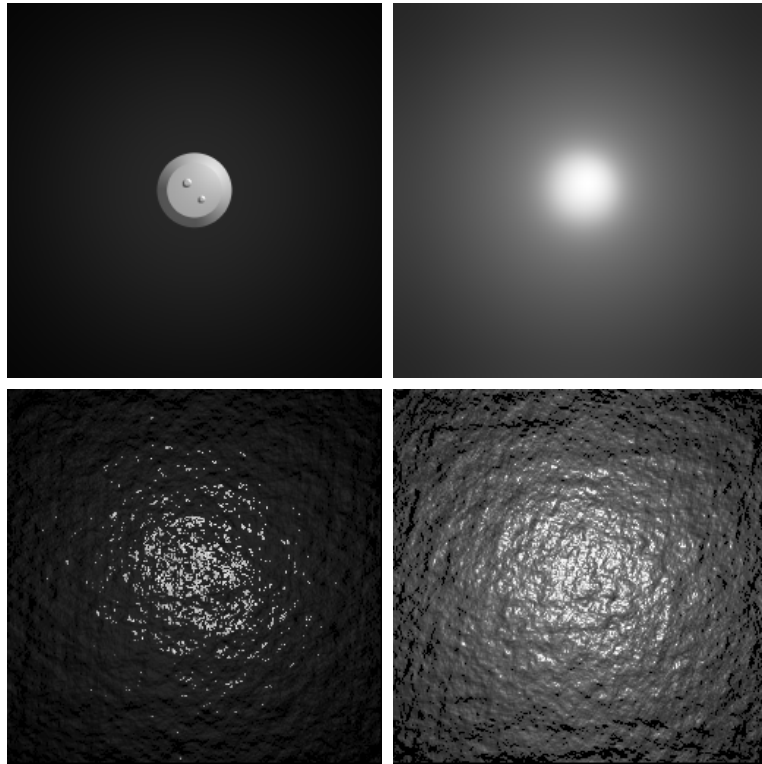
*2. GLM-predicted performance of airborne
pulsed range-gated system*

RESULTS

Project is in its preparatory stages and no significant results can be reported so far.

IMPACT/APPLICATIONS

It is expected that the project will lead to a number of transitions to NAVOCEANO for the processing, analysis, evaluation, and manipulation of optical data (hyper- and multi-spectral) in support of Navy optically-based systems (divers, cameras, laser systems).

TRANSITIONS

Models and algortihms supporting the above results are to be transitioned to NAVOCEANO.

RELATED PROJECTS

Discussed at length in text.

REFERENCES

R. A. Arnone, "Integrating Ocean Color Satellites into Naval Operations", Backscatter, Aug. 1999, page 8.

PUBLICATIONS

McBride, W.E. III, and A. Weidemann, "Meeting Navy Needs with the Generic Lidar Model", presented at SPIE's 44th Annual Conference in Denver, CO, July, 1999.